

# RECORDS OF THE QUEEN VICTORIA MUSEUM LAUNCESTON

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## EROSION SURFACES IN WESTERN TASMANIA

By

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### ABSTRACT

The topography of Western Tasmania is discussed and the marked concordances of summit, ridge and plain are placed into five levels at 4,400 to 5,300 feet, 3,900 to 4,400 feet, 3,000 to 3,500 feet, 2,400 to 2,700 feet and 300 to 1,400 feet. They are shown to be uplifted erosion surfaces and the possibility of them being faulted counterparts of one, or more, levels is discounted except in the area between the West Coast Range and the sea. East of the West Coast Range the Permian land surface transgresses these levels from 3,200 feet at Mt. Sedgwick to 2,400 feet near Lake St. Clair and its uniform easterly dip demonstrates the absence of major post-Permian faulting although the area as a whole has been uplifted. However, west of the West Coast Range this ancient land surface is at sea level; the Upper Cainozoic sediments at Macquarie Harbour are affected by faulting of this same age, and younger. Both of these relationships indicate extensive post-Permian faulting which would have effected the late Mesozoic and Cainozoic erosion surfaces in this area.

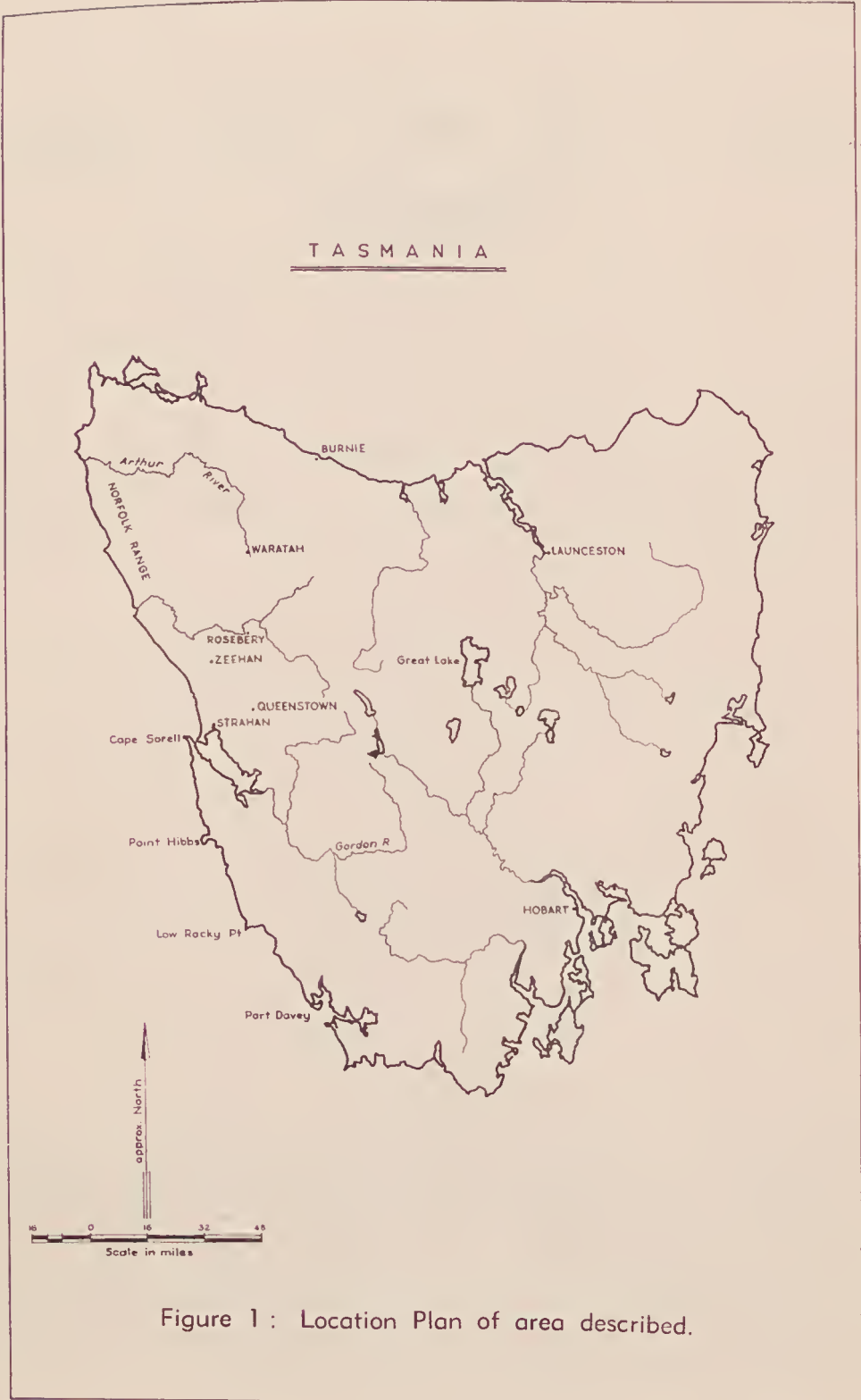


Figure 1: Location Plan of area described.

## INTRODUCTION

It has long been generally recognised that the topography of western Tasmania<sup>1</sup> shows a marked concordance of summit, ridge and plain heights at certain levels. These observations commenced with Gregory (1903) who recognised an extensive low level surface from his observations which he made on his visit to Queenstown via Burnie; this was his Henty "peneplain" and N.W. Plateau. This period was the time of a vigorous mining boom on the West Coast and from 1908 to 1915 thirteen Geological Survey Bulletins were issued by the Tasmanian Department of Mines which reported an area bounded on the north by the Pieman River, east to Rosebery and Queenstown and southwards to Macquarie Harbour and Point Hibbs. The sections on the topography extended and qualified the earlier work of Gregory and also recognised a higher level at approximately 2,500 feet (Ward, 1911, p. 8). In the previous year Twelvetrees and Ward (1910) had recognised the pre-Permian surface at Mt. Dundas although Gould (1860) was the first to describe the occurrence of this ancient land surface on the West Coast. In one of the last of the Geological Bulletins of this period, that describing the South Heemskirk Tin Field, Waterhouse (1911, p. 17) presents an admirable summary of the topography of the area under discussion and summarises the information gained by the previous publications. A gap of several years followed until Clemes (1925) described three surfaces (2,000 to 2,500 feet, 3,000 to 3,500 and an upper surface represented by the mountain tops) from the Lake St. Clair and Central Plateau region. Publications after 1925 do not specifically deal with the south-west of Tasmania but with the island as a whole. Lewis (1934, 1940, 1945 and 1946) refers to a preponderance of altitudes at approximately 1,500 feet, 2,500 feet and 4,000 feet. Nye and Blake (1938) recognised two major surfaces, at 3,000 to 5,000 feet and a lower one at about 2,000 feet. The former was thought to have been of late Cretaceous age with the latter of Oligocene age. They referred to the Henty surface of Gregory (1903) as the Western Peneplain and considered it to be either a third level not reaching above 1,000 feet and of post-Miocene age or a tilted portion of their lower surface of 2,000 feet. This latter surface is represented in the north-west of the State by their north-western Peneplain. Browne (1950, p. 111) recognised the existence of at least three surfaces. The highest of between 4,000 to 5,000 feet was represented on the west coast by the peaks at the Eldon Range, Frenchman's Cap and around Lake St. Clair. His 3,000 to 3,500 surface extended from Lake St. Clair with the peaks of the West Coast Range belonging to the same level. The 2,000 to 2,600 feet surface he named the St. Clair surface, being typically developed about the Lake St. Clair-Derwent Bridge area. On the West Coast he recognised the Henty surface reaching 900 to 1,000 feet in height and he considered the possibility that this level was continuous with the St. Clair surface at Waratah, that is, a downfaulted or downward warped portion of this 2,000 to 2,500 level. The 3,000 to 3,500 feet level was thought to be of a Cretaceous or early Tertiary age whilst the St. Clair level was correlated with the Miocene peneplain of Queensland and New South Wales.

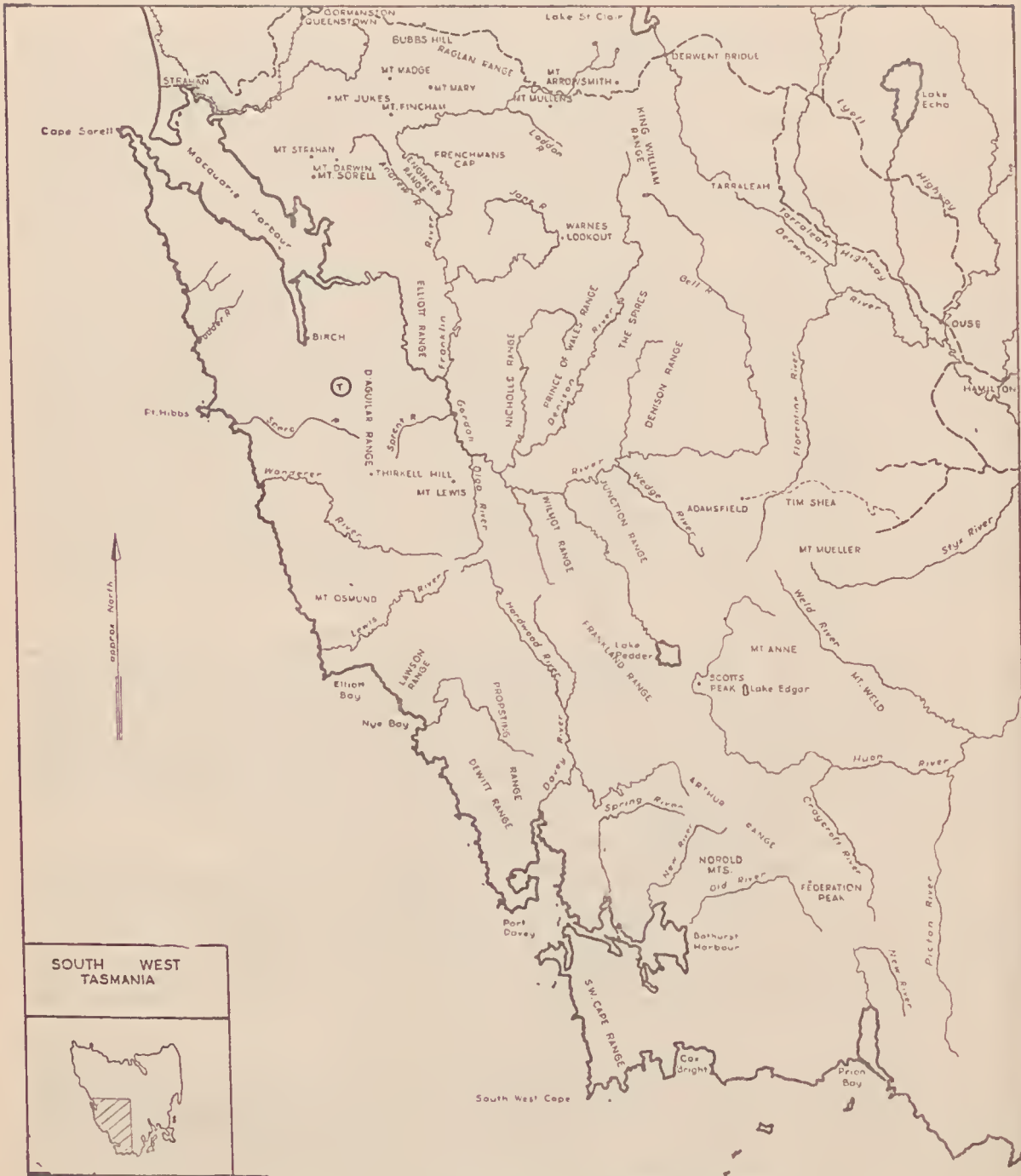
It is interesting to note that the reviews of Nye and Blake and Browne are primarily based on work completed prior to 1925. It is quite obvious, however, that there was no unanimity of opinion as regards the number of surfaces or their height. Opinion followed two distinct paths, either there were different surfaces formed at varying elevations or the apparent abundance of such levels was the result of the faulting or warping of one, or two, erosion surfaces. The almost overwhelming drawback to these discussions prior to 1958 was the absence of accurately contoured topographical maps. This has recently been remedied by the Department of Lands and Surveys of Tasmania and a series of maps at a scale of over two inches to the mile and contoured at a 50 feet interval is being prepared to cover most of the State. Several have already been prepared and their existence led Davies (1959) to present the first systematic study of the various erosion levels in Tasmania. Davies recognised six major levels and the elevations of these are reproduced in Table I. His general conclusion is that they represent uplifted sub-aerial erosion surfaces although the lowest (Lower Coastal surface which part equals the Henty surface on the west coast) may be largely of marine origin.

The high peaks of plus 4,400 feet are cited as possible residuals of a surface which can be correlated with the Mesozoic surfaces of continental Australia. However, the only levels which Davies safely ascribes to this ancient surface are the downfaulted and buried bauxites of the Launceston and Onse districts. Following this the mature landscape was broken by extensive faulting which occurred either at the end of the Mesozoic or beginning of the Tertiary period. A long period of planation followed which lasted through Eocene and Oligocene and possibly into the Miocene during which extensive erosional and depositional plains were formed (see also Carey, 1947). Remnants of this surface, if they still exist, would probably be the higher plateau level of 3,900 to 4,400 feet. In the latter half of the Cainozoic an intermittent uplift commenced erosion once again which carved the lower surfaces out of this single mid-Tertiary surface.

Since Davies prepared his paper further contoured sheets have been made available by the Department of Lands and Surveys, notably the 4 Pillinger sheets and the 4 Zeehan sheets. Also an amount of elevations have come from the exploration work which has recently been carried out by the Mt. Lyell Mining & Railway Co. Limited and the Electrolytic Zinc Company of Australasia Limited in the area from Macquarie Harbour to Port Davey. The use of helicopters in this area has allowed the determination of the elevation of hitherto inaccessible localities by barometer. Since the reconnaissance traverses with the helicopter were always of a short duration (less than two hours) and the barometers were set to sea level at the commencement and end of the traverses the elevations given can be taken to be accurate to within 25 feet. This accuracy is sufficient for the correlation of major erosion surfaces.

1. The area under discussion in this paper is limited by the Pieman River on the north, Rosebery, Lake St. Clair, Lake Pedder and Port Davey in the south.

## EROSION SURFACES IN WESTERN TASMANIA



Scale : 16 miles to 1 inch.

Figure 2: Location Plan of S.W. Tasmania

## EROSION SURFACES

### *Henty Surface (300 to 1,400 feet)*

One of the most striking points of interest when the West Coast is viewed from Macquarie Harbour is the various levels which are developed in the Cainozoic and associated Lower Palaeozoic sediments. These levels are very well developed in the former sediments at the south end of Birch Inlet but the most striking example is the 900 and 1,400 feet level which has been carved into the Owen Conglomerate on the western sides of the D'Aguilar and Mt. Sorell Ranges respectively (Figure 3). The heights of these various levels are summarised in Table II.

Considering those to the south of the Harbour first of all, the level of 800 feet is considered to represent the general level of the Henty surface<sup>1</sup> of Gregory (1903) with the lower levels developed along the river valleys which have cut into this surface. At the D'Aguilar Range, it rises to 900 feet and gently slopes to the west at an average rate of about 80 feet to the mile, to within about one mile of the sea coast. Its grade then steepens and it typically appears at the coast as cliffs up to 100 feet in height, such as at High Rocky Point, forming a rugged shore line. The surface also appears to be gently sloping to the south and the effect of this is readily apparent in the more hospitable coastline south of the Wanderer River, and especially so south of Low Rocky Point, where wide sandy beaches, with an absence of cliffs, are apparent. The plain can be seen continuing southwards towards Port Davey as a narrow coastal strip which rises inland towards the Lawson and De Witt Ranges. This low level surface appears to be either absent or very poorly developed in the extreme south-west of the State.

The surface is gently undulating with low monadnocks of Precambrian, such as Elliott Hill, Owen Conglomerate (Ordovician) at Mt. Osmund and of the Dundas Group (Cambrian) at Wart Hill. On a broader scale the West Coast, D'Aguilar and Lewis Ranges also appear to be monadnocks rising 2,500 to 3,500 feet. It is interesting to note that whilst the D'Aguilar Range is the direct southerly continuation of the West Coast Range, south of the Wanderer River this feature has been reduced to the Henty surface level and forms the area known as Tabletop. The only remnant of what must have been its former grandeur and ruggedness in this locality is the monadnock of Mt. Osmund, a low round hill rising to about 1,210 feet.

On the western flank of the D'Aguilar Range there is a localised surface in Cainozoic sediments at 1,200 feet (Figure 3). This surface can be traced for several miles northwards to the Gordon River. The development of this localised surface is considered to be due to vertical movement on the Lyell Shear and Long Fault which post dates the formation of the Henty surface.

To the north of the Harbour the Henty surface, and its extension, has been adequately described elsewhere by Gregory (1903), Twelvetees and Ward (1910), Ward (1911), Hills (1914 a, b & c), Waterhouse (1914 & 1916) and recently by Bradley<sup>2</sup> (1954), Wade and Solomon (1958) and Banks and Ahmad (1959). In the Queenstown area, the plain is at 800 to 1,000 feet, rising to 1,200 in the West Coast Range and falling to 5 to 600 feet above sea-level at the sea coast near Strahan, an average slope of about 50 feet per mile. It is considered to be equivalent to the Little Henty Peneplain near the Heemskirk Range which is at 700 feet Waterhouse, 1916) and the surface described by Ward (1911) at 800 feet near Balfour in N.W. Tasmania (see also Gregory, 1903, pp. 177-178).

Banks and Ahmad (1959) describe the Henty surface at the Henty River area (Malana) at an elevation of 720 feet ( $\pm$  10 feet) above sea-level and sloping seaward at an average rate of 60 feet per mile. Associated with this is a lower, and apparently younger, surface at an elevation of 350 to 400 feet which Banks and Ahmad call the Firewood Siding surface. This lower surface appears to be part of the Western Peneplain of Gregory (1903, pl. XX). Davies (1959) places the elevation of this surface as between 300 to 900 feet. On the West Coast this upper limit is considered to be too low as the surface can be traced continuously from 300 feet to the mentioned height of 1200 to 1400 feet at the edge of the West Coast Range north of Macquarie Harbour. (See State Topographical sheets Pillinger A and Lyell A & C. 2 inches to 1 mile, contour interval of 50 feet). East of the West Coast Range this low level surface is present at 1,200 feet in the King River valley at least northwards to the junction of the King River and the South Eldon River (near Eldon Peak) and southwards to the continuation of this valley via the upper Andrew and Nora Rivers to the Gordon River. The plains in the Craycroft Range (1,400') and those associated with the Deception and Surveyor Range further to the east are at an elevation of 800 to 1,400 feet. The extensive Lighting Plains between the Jane River and Frenchmans Cap are also at this same general elevation, at 1,400 feet. Similarly the Collingwood River plain is at an elevation of 1,200 to 1,400 feet.

### *Age of Henty Surface*

Banks and Ahmad (1959), in their description of the surface in the lower Henty River area, describe its development in Permian sandstone and dolerite, the latter being presumably of lower Jurassic age. In the Macquarie Harbour area the surface is developed in the Cainozoic sediments and consequently must post-date the deposition of these. The age of these sediments has been given as Upper Cainozoic (E. D. Gill in Scott, 1960), probably Pliocene, thus also placing the formation of the Henty surface as post Pliocene. Since this event, the surface has been uplifted several hundred feet with

1. Gregory (1903, pl. XX) restricted his term Henty Peneplain to an area banded on the east by the West Coast Range, on the south by the King River, north by the Little Henty River and to within a few miles of the coast where his Western Peneplain commenced. However, earlier in this paper (op. cit., p. 177) he describes the peneplain as extending in a broad band parallel to the west coast, at least from the Arthur River in the north to some distance south of Macquarie Harbour. This southerly continuation of the Henty surface is most apparent when the Macquarie Harbour area is viewed from a low flying aircraft. Thus the use of the term Henty surface beyond its original limits is considered to be justified.

2. Bradley (1954, p. 195) uses the terms Howard's Peneplain and Henty Peneplain. The former is given as being present at 1,100 feet in the Andrew and King River Basins whilst the latter surface stands between 400 to 500 feet lower, and is the level of the old flood plain of the King and Queen Rivers. This is not the definition given to the Henty surface by Gregory (1903). Presumably the type area for the Howard's Peneplain is Madame Howard's plain, to the north west of Queenstown. This plain is an essential part of the Henty surface as described by Gregory and consequently it would be best if use of the term Howard's Peneplain were discontinued.

the result that the rejuvenated rivers have cut gorges up to 100 to 200 feet below the level of the plain with the development of knick points, incised meanders and examples of river capture. The extensive development of the local surfaces (see Table II) of lower elevation than that of the Henty is considered to be related to this relative uplift and following erosion, their horizontal development would indicate that the uplift was not continuous but occurred in a cycle of a maximum and then a minimum movement. As has already been discussed on page 5, the localised surface at 1,200 to 1,400 feet in the Cainozoic sediments is considered to be due to vertical movement on the Lyell Shear which post-dated the development of the Henty surface: this higher surface which is composed of highly friable sandstones and conglomerates, is being rapidly removed by erosion in an area of high rainfall (+ 50 inches per annum). Faults disturbing the Cainozoic sediments have also been noted at Clarks Bay on Macquarie Harbour and in Moore's Valley, approximately 20 miles south of Birch Inlet. Davies (1959) places a higher coastal surface on the West Coast at a general height of 1,200 to 1,500 feet. This surface is apparently very well developed in the south-east part of Tasmania with the lower coastal surface standing below it at 900 feet. In the western half of the island he relates well marked and extensive valley flats to this higher surface. However, the Henty surface on the West Coast includes this elevation range, as already described above. It forms a gradual slope rising from 300 feet near the coast to 1,200 to 1,400 feet inland and east of the West Coast Range. Consequently the higher coastal surface would appear to be absent or exceptionally poorly developed in the area under discussion.

#### *St. Clair Surface (2,400 to 2,700 feet)*

The St. Clair surface was originally described by Clemes (1929) as the 2,000 to 2,500 feet level in the Lake St. Clair Region. Browne (1950) was the first to use the term "St. Clair surface". Davies (1959) defines its elevation as between 2,400 to 2,700 feet and this is accepted here.

In the area under discussion it is most clearly seen in the Lake St. Clair-Derwent Bridge area. On the west coast it was recognised as an accordance of summits and ridges by many of the earlier works during the period 1908-1915, being first mentioned by Ward (1911 p. 8). North of Queenstown it can be recognised at the Norfolk Range, the Heemskirk Range, Mt. Zeehan, Parsons Hood and Mt. Livingstone. Nearer to Queenstown Moore (1894) and Johnston (1894) recognised this general level in the Mt. Tyndall area. To the east of Queenstown Mt. Lyell, the north end of Mt. Owen, the north slopes of Frenchman's Cap, Mt. Maud, Collingwood Range, Engineer Range, Mt. Fincham, Mt. Madge and the Deception Range all attain this general elevation. South of Queenstown, Mt. Strahan, Mt. South Darwin, D'Aguilar Range, Mt. Lewis and the Lawson and DeWitt Ranges attain a similar altitude. Similarly most of the major Ranges between Mt. Lewis and the Rasselas Valley to the east appear to attain a similar elevation, such as the Hamilton, Wilmot and Junction Ranges. Also the Ranges east of Bathurst Harbour such as the Ironbound, Spero and Norold approximately attain 2,400 feet.

#### *Lower Plateau Surface (3,000 to 3,500 feet)*

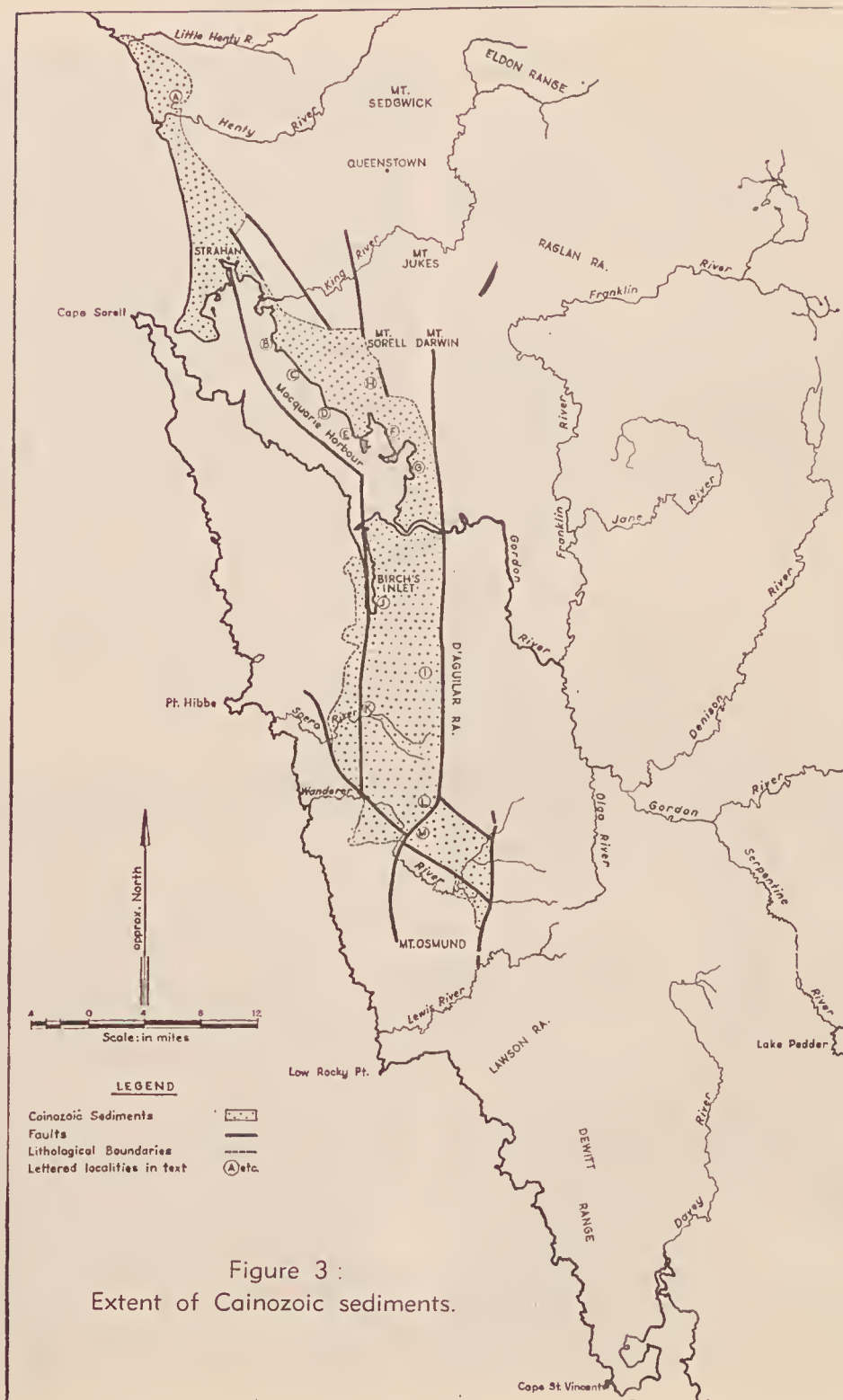
This surface was designated the "Intermediate" level by Clemes (1925) who described it as the Traveller Plateau at an elevation of 3,000 to 3,500 feet. This elevation is also adopted by Browne (1950), Davies (1959) and the author. The surface is best developed outside the area at present being discussed, at the Great Lake. However, most of the prominent peaks on the West Coast Range attain this height as Mt. Sedgwick, Mt. Owen, Mt. Jukes, Mt. Darwin and Mt. Sorell. To the east the Raglan Range has quite extensive plains at this elevation, Mt. Mary, Mt. Sprent, north slopes of Frenchman's Cap, Last Hill, Rocky Hill and Pyramid Hill all have plains at this elevation. Similarly Mt. Arrowsmith has a plateau at about 3,200 feet.

The pre-Permian plane of unconformity has been extensively stripped at this elevation. At Mt. Sedgwick it is at 3,200 feet (see also Edwards, 1941) where Palaeozoic sediments. To the north the same unconformity can be seen at Mt. Dundas at about the same elevation. This stripped unconformity at Mt. Sedgwick forms part of the Lower Plateau surface. Similarly the small plateaus at this elevation elsewhere on the West Coast Range (particularly that at Mt. Jukes) can no doubt also be related to this stripped unconformity although positive proof in remnants of Permian sediments has not been located. To the east this unconformity is readily apparent at Eldon Bluff and the east to west ridge of high land which runs through Last Hill, Rocky Hill, Pyramid Hill to Goulds Sugar Loaf and Mt. Hugel (Gould, 1860). The unconformity, Permian on folded Lower Palaeozoic or Precambrian, has been visited at Last Hill and it is readily apparent on aerial photographs at the other localities. At Last Hill it is at an elevation of about 3,000 feet and at Pyramid Hill 2,800 feet. The Precambrian can be seen beneath the Permian in the Franklin River valley between Lakes Dixon and Undine with the unconformity at about 2,400 feet. The same unconformity is also present further to the south in the Surprise River valley. From the Last Hill to Lake Dixon the unconformity has an average slope of 45 feet to the mile. It is interesting to note how this tilted ancient land surface "transgresses" the younger surfaces, forming part of the 3,200 feet level in the West Coast Range and the 2,500 feet surface at Lake St. Clair some 28 miles to the east.

West of Queenstown, at the coast, Permian sediments have been recognised at sea level at the lower Henty River and at Point Hibbs. The position of these sediments and associated dolerite is at least 3,000 feet below those found in the West Coast Range and their faulted relationship with the associated Palaeozoic sediments indicates that they have been brought to this position by extensive post-lower Jurassic fault movement.

#### *Higher Plateau Surface (3,900 to 4,400 feet)*

This is defined by Davies (1959) as generally at an elevation of 3,900 to 4,400 feet. This elevation is well represented in the northern part of the area under discussion. Mt. Murchison, Mt. Tyndall, Eldon Range and Bluff, Rocky Hill, Pyramid Hill, Goulds Sugar Loaf, an unnamed plateau between the Sugar Loaf and Mt. Hugel, King William Range, the plateau below Mt. Hugel and Mt. Gell as well as several other adjacent



localities show this surface. The Frenchman's Cap plateau is about the only representative of this surface outside this northern zone.

#### *High Monadnocks (plus 4,400 feet)*

Standing above the Higher Plateau surface are peaks such as Frenchman's Cap (4,750 feet) and Mt. Olympus (4,746 feet). The best examples of these peaks are beyond S.W. Tasmania in the Mt. Ossa, Pelion, Barn Bluff and Cradle Mountain area all of which rise above 5,000 feet.

### *RELATIONSHIP OF SURFACES*

A study of the various contoured topographical sheets which are available for S.W. and Western Tasmania shows that each surface is represented within the next lower one by the presence of accordant monadnocks and within the next higher by plains. This relationship led Davies (1959) to the concept of a landscape derived from a mid to late Tertiary uplift of a single peneplain which had been derived from an early (Eocene-Oligocene) period of planation. This concept differed from earlier workers who envisaged the higher levels to represent earlier cycles and the lower levels to either have been faulted or warped into their present position (Browne 1950 and earlier). Two typical examples of the relationship of the surfaces described above will clarify this point. In the Mt. Sorell-Mt. Strahan area the 1,400 feet level of the Henty surface can be seen on the western flank of the mountain. Immediately above this level the St. Clair surface is developed at 2,200 feet at Mt. Strahan and the Lower Plateau surface at 3,200 feet at Mt. Sorell. These three surfaces are developed in the same rock type (Owen Conglomerate) and geological mapping precludes the possibility that the two lower surfaces are downfaulted remnants of the upper surface, or vice versa with up-faulting. At Frenchman's Cap the four surfaces described above are developed about the peak at 4,750 feet, these are at 1,400, 2,200, 3,200 and 3,800 feet respectively. These are all developed in Precambrian metaquartzites and siliceous mica schists and their distribution about the peak again eliminates the possibility of a faulted relationship between these various surfaces. Similarly the absence of major faulting during and after the formation of these surfaces in this area is supported by the constant slope of the pre-Permian unconformity from Last Hill to Lake St. Clair: this unconformity has undoubtedly been regionally tilted since its formation but it has not been disturbed by faulting in the area under discussion. Consequently, the present work entirely supports this concept that these surfaces (with the possible exception of the Henty surface) are uplifted sub-aerial erosion levels. The question of extensive faulting during or after the development of these surfaces has already been discussed and concluded that east of the West Coast Range it is either absent or of negligible proportions. This conclusion is an agreement with Davies (1959) who concluded that the mid-Tertiary planation followed major faulting and that there is no longer any positive evidence for extensive late Tertiary faulting. However, the dating of the non-marine sediments at Strahan as Upper Cainozoic (probably Pliocene) by E. D. Gill (in Scott, 1960) must qualify this viewpoint. These sediments at Strahan form part of an extensive area (225 square miles) of sediments which are several hundred feet thick, at

least 730 feet, and of which at least 560 feet is below the present sea level. These sediments were deposited in the Macquarie Harbour graben, consequently normal faulting of possibly up to 1,000 feet must have taken place on the West Coast during the Upper Cainozoic (probably Pliocene). The Henty surface is developed in the sediments and also crosses the boundary faults to the graben, thus movement on these faults must have largely ceased during the formation of this surface. However, some recent adjustments are considered to have taken place on the eastern boundary fault as discussed on page 5 and shown in Figure 3. A necessary corollary of this upper Cainozoic tectonic movement is that the 2,500 feet level which exists in the Heemskirk Range and at Mt. Zeehan need not necessarily be a correlate of the St. Clair surface, it could be a down-faulted position of a higher surface such as the low plateau level (3,000 to 3,500 feet).

It is interesting to note that this concept of extensive faulting with a considerable downthrow to the west is supported by the position of the pre-Permian unconformity. East of the West Coast Range evidence has been presented to show that apart from a regional tilting to the east it has not been materially disturbed by faulting since its formation. However, west of the Range the Permian sediments are downfaulted from 3,200 feet at Mt. Sedgwick and Mt. Dundas to sea level and below at the Henty River and Point Hibbs. It is appreciated that all of this faulting could have occurred during the late Mesozoic or early Tertiary period. However, it does demonstrate that the major north-south faults which exist between the Range and the coast were active at a time when the region to the east of the Range was one of stability.

### *SUMMARY*

The Tabberabberan folding which took place during the Devonian period was followed by a prolonged period of planation which led to the development of the pre-Permian land surface which is recognisable at various levels between Lake St. Clair and Point Hibbs. The deposition of the Permo-Triassic sediments followed with the intrusion of the dolerite which is usually accepted as Lower Jurassic in age (Banks, 1958). Following this igneous activity there was a prolonged period of stability which produced an extensive and well developed surface of erosion in the Mesozoic, and older, rocks. The only remnant of a surface which can be ascribed to this ancient level is the downfaulted bauxites of the Launceston area, which are developed in dolerite (Carey, 1947). This period of tectonic quiescence was followed in the late Mesozoic or early Tertiary by faulting which broke up this surface. On the West Coast this faulting could have been responsible for the displacement of the pre-Permian surface from 3,200 feet in the West Coast Range to below sea level on the present coast line some 17 miles to the west. Elsewhere in Tasmania the formation of the Launceston Basin and possibly also the Oyster Bay and Derwent grabens can be ascribed to this period of tectonic activity.

The West Coast at this time would have undergone a general uplift but faulting or extensive tilting east of the West Coast Range can be considered to be of negligible proportions owing to the relatively undisturbed conditions of the pre-Permian surface from Mt. Sedgwick to Lake St. Clair. No sediments which can be related to this early and mid-Tertiary period have yet been

identified in the area under discussion. This is in a direct contrast to other areas of Tasmania where marine sediments of Eocene-Lower Oligocene age (Gill and Banks, 1956) were deposited in the Launceston Basin and the marine limestones of Oligocene-Miocene age were formed on the North-West coast, and the Furneaux Islands (Banks, 1957). During this period the extensive Cretaceous land surface which would have been present at some unknown elevation in the area under discussion would have undergone erosion with an undoubted development of lower surfaces. Although there is no direct evidence the complete removal of this surface would seem to be unlikely. If this is the case then the high monadnocks (plus 4,400 feet) such as Frenchman's Cap and the next lower surface, the high plateau surface at 3,900 to 4,400 feet, may well be remnants of this original Cretaceous level plus one of its lower surfaces developed during this early Tertiary. At the close of the Miocene and during the Pliocene intermittent uplift would have caused a rejuvenation of erosion with the formation of lower surfaces and reduction of the area covered by the higher levels. On the West Coast possibly

only the lower plateau (3,000-3,500) and St. Clair surfaces (2,400-2,700 feet) were formed during this interval.

At the end of Pliocene extensive faulting took place west of the West Coast Range with the undoubted disturbance of previously established surfaces and the formation of the Macquarie Harbour graben (Scott, 1960). The cyclic nature of the several hundred feet of the non-marine sediments which fill this structure suggest an intermittent nature to this movement. Elsewhere in Tasmania sediments of a similar age are known at Flinders Island (Banks, 1957). The Henty surface was developed in these former sediments and as this level crosses the boundary faults to the graben movement on these structures must have generally ceased prior to its development. However, some later movement is indicated by the presence of the localised 1,200 feet surface, as discussed on Page 5. This low level surface has recently been uplifted several hundred feet as the Upper Cainozoic sediments at Strahan are 250 feet above the present sea level. This has led to the active erosion of the surface, and indeed all surfaces, with the development of at least four minor levels below, and consequently younger than the Henty level.

TABLE I  
SUMMARY OF ELEVATION OF SURFACES—WEST COAST

| PRE 1915       | CLEMES<br>(1925) | LEWIS      | NYE & BLAKE<br>(1938)    | BROWNE<br>(1950)            | DAVIES<br>(1959)                    | SCOTT<br>(1959)                     |
|----------------|------------------|------------|--------------------------|-----------------------------|-------------------------------------|-------------------------------------|
|                |                  |            |                          | 4,000'-5,000'               | 4,400'-5,300'<br>(CRET. ?)          | 4,400'-5,300<br>(CRET. ?)           |
|                | Plus 3,600'      |            |                          |                             | 3,900'-4,400'<br>(EARLY<br>TERT. ?) | 3,900'-4,400'<br>(EARLY<br>TERT. ?) |
|                |                  | 4,000'     |                          |                             |                                     |                                     |
|                | 3,000'-3,500'    |            | 3,000'-3,500'<br>(CRET.) | 3,000'-3,500'<br>(CRET.)    | 3,000'-3,500'<br>(UPPER<br>TERT. ?) | 3,000'-3,500'<br>(UPPER<br>TERT.)   |
| 2,500'         | 2,000'-2,500'    | (A) 2,500' | (A) 2,000'<br>(OLIGO.)   | (A) 2,500'<br>(MIO.)        | 2,400'-2,700'<br>(UPPER<br>TERT.)   | 2,400'-2,700'<br>(UPPER<br>TERT. ?) |
| 300' to 1,000' |                  | (B) 1,500' | (B) to 1,000'            | 200'-1,000'<br>(B) (MIO. ?) | 1,200'-1,500'<br>300'-900'          | 300'-1,400'<br>(PLIO.-<br>PLEIST.)  |

(A) & (B) All three strongly considered the feasibility that the lower surface was a downfaulted or downwarped portion of the upper, 2,500', surface.

CRET. =Late Cretaceous or Early Tertiary.  
TERT. =Tertiary.  
OLIGO. =Oligocene.  
MIO. =Miocene.  
PLIO. =Pliocene.  
PLEIST. =Pleistocene.  
UPPER TERT. =Post Miocene.  
EARLY TERT. =Pre Miocene.

TABLE II

## SUMMARY OF LEVELS IN MACQUARIE HARBOUR CAINOZOIC SEDIMENTS AND MARGINS

(For location see Figure 2)

| Birch Inlet | Mount<br>Discovery<br>(D'Aguilar<br>Range) | Spero<br>River          | Urquhart<br>River <sup>1</sup> | Moore's<br>Valley <sup>2</sup> | South West <sup>3</sup><br>Coast | Mt. Sorell                 | Strahan     | North of<br>Harbour        |
|-------------|--------------------------------------------|-------------------------|--------------------------------|--------------------------------|----------------------------------|----------------------------|-------------|----------------------------|
|             | <u>1,200'</u>                              | <u>Top not<br/>msd.</u> | <u>800'</u>                    | <u>700'</u> <sup>o</sup>       |                                  | <u>1,400'</u> <sup>o</sup> |             | <u>1,200'</u> <sup>o</sup> |
|             |                                            |                         |                                |                                |                                  | 1,100'                     |             | 1,000'                     |
|             |                                            | 510'                    |                                |                                |                                  |                            |             | 800'                       |
|             |                                            | 460'                    |                                |                                |                                  |                            |             | 400'                       |
|             |                                            | 420'                    |                                |                                |                                  |                            |             | 380'                       |
| <u>300'</u> |                                            | 310'                    |                                | 300'                           |                                  |                            |             |                            |
| <u>200'</u> |                                            |                         |                                | 200'                           |                                  |                            | <u>230'</u> | 210'                       |
| <u>110'</u> |                                            |                         |                                | 120'                           | <u>150'</u>                      |                            | 130'        |                            |
| <u>60'</u>  |                                            |                         |                                |                                | 70'                              |                            | 55'         |                            |
| <u>30'</u>  |                                            |                         |                                |                                |                                  |                            | 30'         |                            |
| <u>15'</u>  |                                            |                         |                                |                                |                                  |                            |             |                            |

Heights underlined indicate the top surface for that area.

All heights measured by aneroid barometer, accurate to plus or minus 25 feet. Heights marked ° are checked against State Topographical Survey sheets, contour interval of 50 feet.

1. Urquhart River is immediately south of the Wanderer River.
2. Moore's Valley is immediately south of Thirkell Hill.
3. Raised beach levels on ocean coast between Point Hibbs and Elliott Bay.

TABLE III

## SURFACE ELEVATION

|                                     |                                                                                            |
|-------------------------------------|--------------------------------------------------------------------------------------------|
| HIGH MONADNOCKS<br>(PLUS 4,400')    | Developed in dolerite (Lower Jurassic) at Cradle Mountain and Lake St. Clair.              |
| UPPER PLATEAU<br>(3,900' to 4,400') | Developed in dolerite (Lower Jurassic) at Lake St. Clair.                                  |
| LOWER PLATEAU<br>(3,000' to 3,500') | Developed in dolerite (Lower Jurassic) at Lake St. Clair and Great Lake.                   |
| ST. CLAIR<br>(2,400' to 2,700')     | Developed in Tertiary basalt at Waratah.                                                   |
| HENTY<br>(300' to 1,400')           | Developed in Upper Cainozoe, probably Pliocene, non marine sediments at Macquarie Harbour. |

The table summarises the youngest rocks in which the surfaces are developed. Since each lower surface is considered to be younger than the next higher one the table also provides a minimum age for the surfaces.

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